

PRELIMINARY DATA SUMMARY

June 1987

U.S. Army Engineer Waterways Experiment Station  
Coastal Engineering Research Center  
Field Research Facility  
Duck, North Carolina

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CERC Field Research Facility  
Duck, North Carolina

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Field Research Facility Measurement and Analysis Work Unit at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility in Duck, North Carolina. The data were collected and the analyses performed by the FRF staff. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

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## I. INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Fig.1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The FRF consists of a 561-m (1,840 ft) long concrete research pier supported on 0.91 m (3 ft) diameter steel piles. The pier deck is 6.1 m (20 ft) wide, 7.74 m (25.4 ft) above mean sea level (MSL), and extends from behind the dunes to approximately the 7.6 m (25 ft) depth contour. In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Most of the data are daily observations or the results of preliminary data analysis. In many instances, continuous analog records and more extensive analyses will be made available later by the CERC Coastal Engineering Information and Analysis Center (CEIAC).

Table 1 is a list of instruments used, their status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depth at the wave gages and current meters vary and may best be determined from the information contained in Figure 8. Other installation information is contained in Table 1. All times unless otherwise specified are referenced to Eastern Standard Time (EST).

Section II presents the meteorological data; Sections III through VI, oceanographic data; Section VII, nearshore profiles and bathymetry; and Section VIII, if included, documents special events that occurred at the FRF during the month.

Questions and/or comments concerning the data may be directed to Mr. Herman C. Miller at (919) 261-3511.

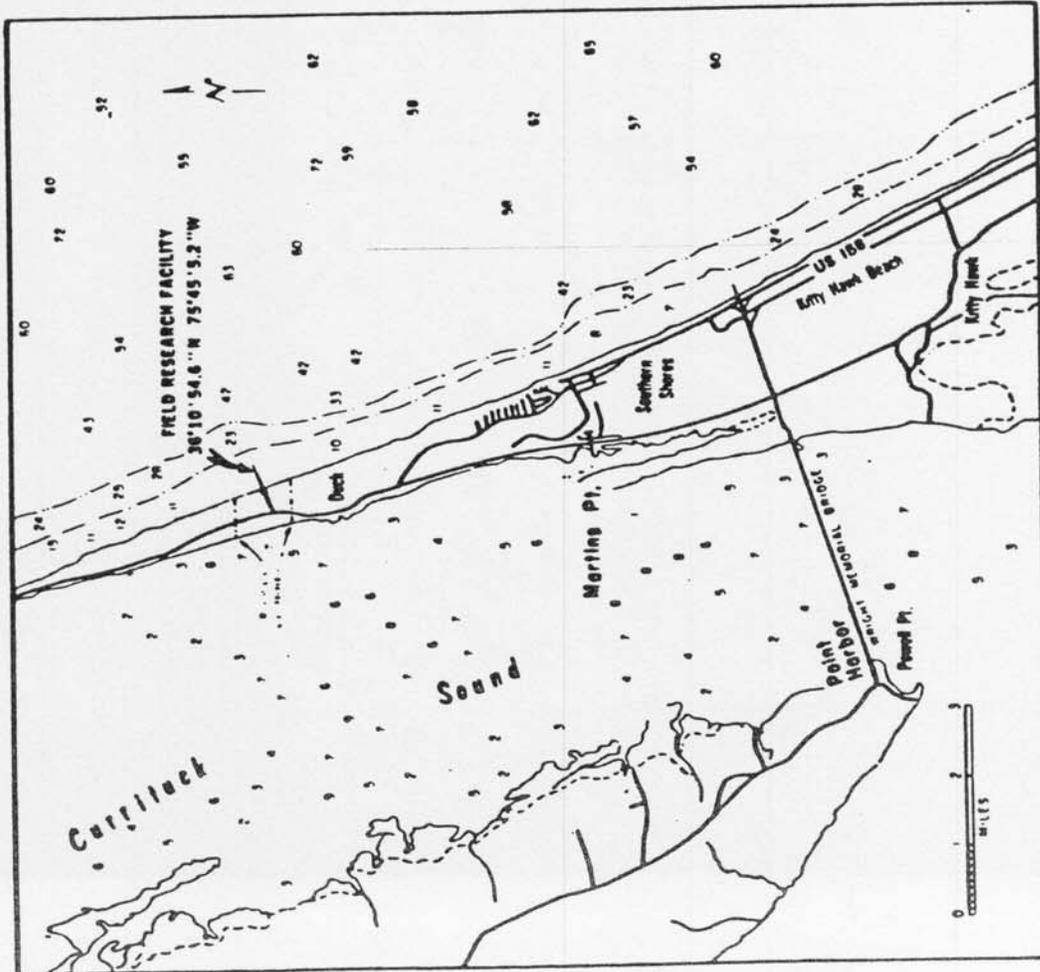
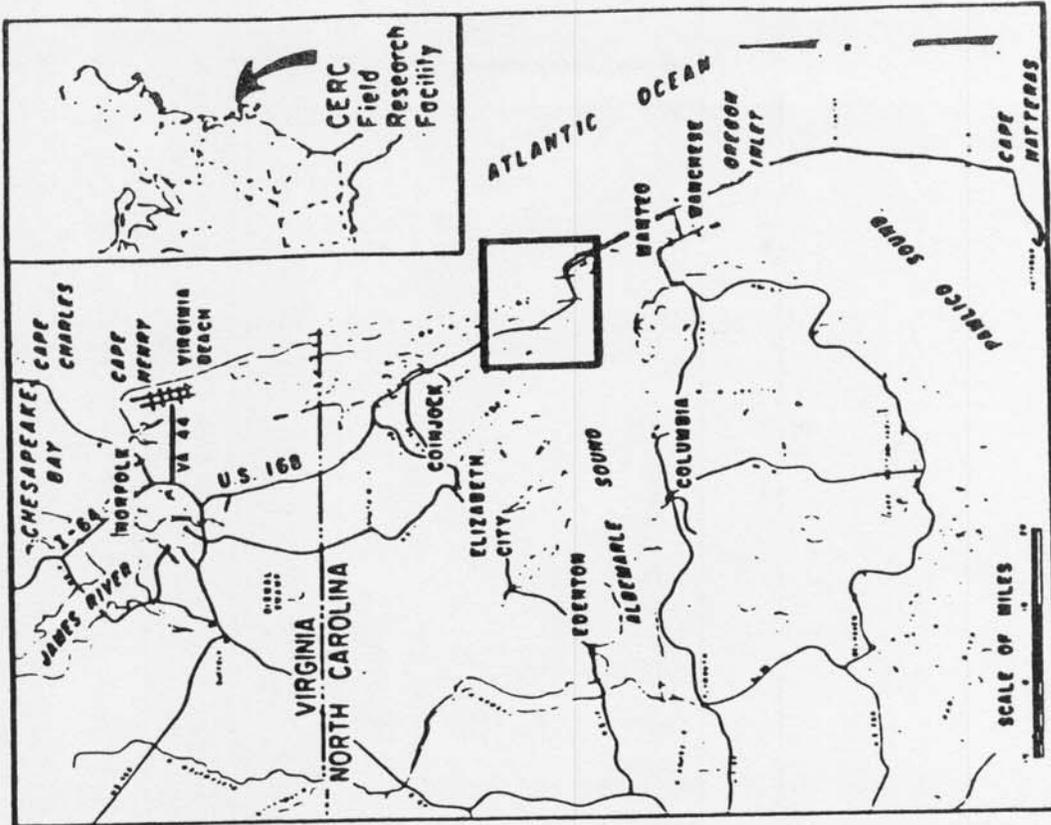


Figure 1. FRF Location Map



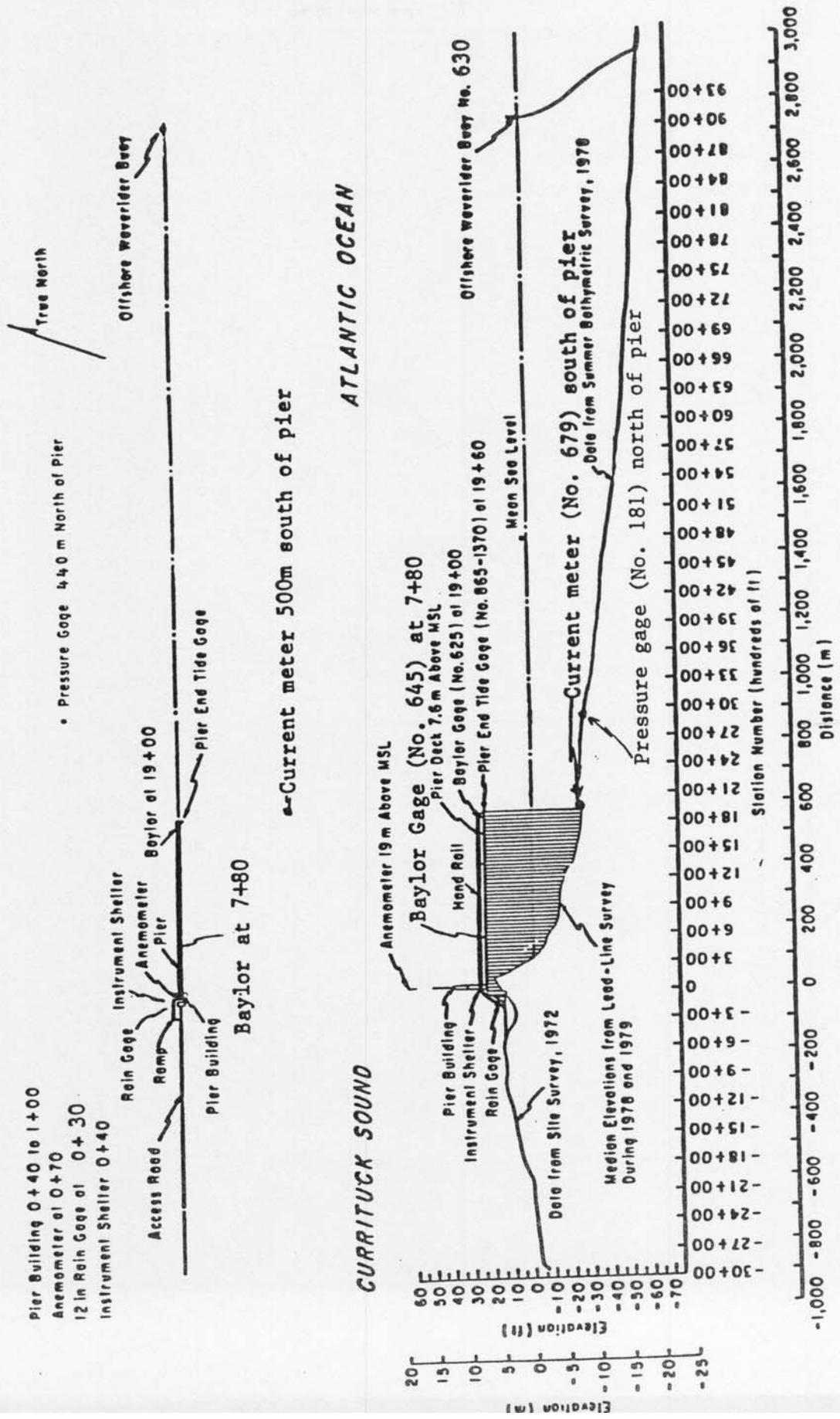


Figure 2. Instrument locations at FRF.

## II. METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Fig. 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

The wind measurements are obtained from a Weather Measure Skyvane located on the FRF laboratory building (Fig. 2), 19.1 m above mean sea level (MSL).

The high and low temperatures are obtained from daily readings of NWS maximum and minimum thermometers and represent the extreme temperature values since the last reading.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in) -  
 $\text{mm} \times .03937 = \text{in}$
2. Millibars (mb) to inches of mercury (in Hg) -  
 $\text{mb} \times 0.02953 = \text{in Hg}$
3. Degrees Celcius (C) to degrees Fahrenheit (F) -  
 $(\text{C} \times 9/5) + 32 = \text{F}$
4. Meters per second (m/s) to knots (kn) -  
 $\text{m/s} \times 1.943 = \text{kn}$



TABLE 2: Meteorological Data  
JUN 1987

Day	Hour	Wind Speed (m/s)	Wind Direction (deg TN)	Temperature (deg C)	Atm Pressure (mb)	Precipitation (mm)
17	100	5	255	23.3	1013.3	3
	700	3	266	24.5	1014.6	0
	1300	2	68	26.5	1016.0	0
	1900	5	67	20.4	1017.7	0
18	100	7	66	20.1	1019.3	0
	700	5	62	21.1	1021.0	0
	1300	6	53	21.4	1021.7	0
	1900	5	72	20.7	1020.4	0
19	100	4	97	21.4	1019.3	0
	700	3	76	22.8	1019.7	0
	1300	4	107	25.9	1018.3	0
	1900	2	138	23.8	1016.0	0
20	100	5	242	24.6	1015.3	0
	700	4	243	25.0	1014.9	0
	1300	5	237	30.5	1013.6	0
	1900	6	219	28.9	1011.9	0
21	100	9	241	25.6	1012.6	0
	700	7	233	25.5	1012.9	0
	1300	6	222	31.2	1011.6	0
	1900	6	226	28.3	1010.5	0
22	100	7	230	25.9	1011.6	0
	700	7	236	26.0	1012.2	0
	1300	7	244	28.8	1011.9	0
	1900	7	224	27.9	1010.2	0
23	100	9	237	25.9	1010.5	0
	700	10	246	26.3	1011.6	0
	1300	7	222	31.3	1010.2	0
	1900	7	223	27.2	1010.2	0
24	100	0		21.6	1010.5	0
	700	8	33	19.1	1012.6	0
	1300	9	18	19.6	1014.6	0
	1900	7	23	19.3	1013.9	0
25	100	2	334	17.3	1013.9	0
	700	3	316	20.3	1013.9	0
	1300	4	96	24.3	1013.6	0
	1900	5	116	21.3	1012.6	0
26	100	2	151	21.2	1012.2	0
	700	3	131	23.0	1011.9	0
	1300	6	148	23.3	1010.5	0
	1900	4	182	25.6	1008.5	0
27	100	1	325	22.3	1007.8	10
	700	3	302	23.9	1007.8	0
	1300	3	293	27.1	1008.2	0
	1900	3	210	26.8	1008.5	0
28	100	7	290	24.9	1010.9	0
	700	7	11	22.0	1015.3	0
	1300	5	61	24.3	1017.0	0
	1900	5	108	21.9	1018.0	0
29	100	4	168	20.4	1020.0	0
	700	3	199	24.9	1021.7	0
	1300	7	131	28.1	1022.7	0
	1900	5	156	23.5	1021.7	0
30	100	5	206	24.0	1021.7	0
	700	5	222	25.5	1023.1	0
	1300	4	194	31.1	1021.4	0
	1900	5	190	26.7	1020.0	0

### III. WAVE DATA

Wave data are collected from two Baylor staff gages (Gages 625 and 645), a pressure wave gage (Gage 181) and a Waverider buoy (Gage 630) as shown in Table 1 and Figure 2. The data are collected, analyzed, and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750 programmed to sample the wave gages every 6 hrs near 0100, 0700, 1300, and 1900 EST. The sampling rate is two times per second for 34 minutes.

Wave height ( $H_{m0}$ ) is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gage has been compensated for hydrodynamic attenuation using linear wave theory. The wave period is identified from the computation of a variance (energy) spectrum with 60 deg of freedom calculated from a 34-min record. The period ( $T_p$ ) is that associated with the maximum energy density in the spectrum. When this analysis is complete, the data are written to magnetic tape.

Table 3 presents the wave heights and periods for each wave record obtained during the month. The monthly means and standard deviations from the means shown in Table 3 are average values computed for all data records collected. Figure 3 is a time history of the  $H_{m0}$  and  $T_p$  values for all gages.

Differences in wave periods between wave gages (Table 3 and Figure 3) may be the result of wave breaking, wave reformation, or the presence of multiple wave trains containing nearly equal energy.

TABLE 3: WAVE DATA

Part 1

JUN 1987

Day	Hour	645		625		181		630	
		Baylor Hmo(m)	at 7+80 T(sec)	Baylor Hmo(m)	at 19+00 T(sec)	Pressure Hmo(m)	Gage T(sec)	Farshr Hmo(m)	Wvrdr T(sec)
1	0100	0.30	11.14	0.37	10.66	0.42	10.66	0.54	10.66
	0700	0.21	11.14	0.35	10.24	0.47	10.66	0.46	9.84
	1300	0.26	10.66	0.33	10.66	0.40	10.66	0.39	10.24
	1900	0.25	10.66	0.32	10.66	0.36	10.66	0.38	10.66
2	0100	0.28	9.84	0.34	9.84	0.41	10.66	0.37	9.84
	0700	0.22	9.84	0.37	9.48	0.42	9.48	0.45	9.84
	1300	0.27	9.84	0.33	9.84	0.39	9.84	0.38	10.24
	1900	0.23	9.14	0.34	9.48	0.38	9.48	0.39	8.83
3	0100	0.22	9.48	0.32	9.84	0.37	9.84	0.35	9.14
	0700	0.21	8.83	0.35	9.48	0.40	8.00	0.34	8.53
	1300	0.39	11.64	0.45	2.69	0.41	8.83	0.50	9.14
	1900	0.51	3.55	0.68	3.46	0.45	3.66	0.72	3.46
4	0100	0.47	3.46	0.60	11.64	0.47	11.14	0.60	11.14
	0700	0.53	3.71	0.73	3.55	0.51	3.41	0.70	10.66
	1300	0.61	5.69	0.78	5.95	0.68	6.09	0.85	6.40
	1900	0.59	6.24	0.92	8.00	0.90	9.48	0.97	6.92
5	0100	0.60	8.53	0.93	9.48	0.98	9.84	0.96	8.53
	0700	0.85	3.82	1.01	9.14	0.89	8.26	1.16	8.83
	1300	0.91	4.49	1.13	4.57	0.82	4.66	1.26	4.41
	1900	0.66	5.22	0.89	8.83	0.75	5.02	0.95	8.53
6	0100	0.47	5.22	0.79	8.00	0.72	8.26	0.86	5.69
	0700	0.46	7.11	0.73	8.26	0.73	7.53	0.85	7.53
	1300	0.62	6.57	0.76	8.53	0.63	3.46	0.75	7.53
	1900	0.65	3.41	0.79	3.20	0.56	3.32	0.79	3.28
7	0100	0.52	4.66	0.68	5.45	0.59	5.22	0.73	5.22
	0700	0.47	5.22	0.64	8.26	0.63	5.45	0.68	5.45
	1300	0.53	2.56	0.75	7.32	0.67	7.32	0.80	7.11
	1900	0.47	9.84	0.68	10.24	0.66	9.14	0.93	3.88
8	0100	0.30	10.66	0.53	8.83	0.58	9.84	0.72	8.83
	0700	0.30	11.14	0.45	8.83	0.55	9.14	0.69	9.48
	1300	0.31	9.48	0.44	9.48	0.52	10.24	0.51	8.53
	1900	0.34	10.66	0.36	9.48	0.44	9.48	0.53	8.26
9	0100	0.33	9.84	0.42	10.24	0.43	10.24	0.55	2.29
	0700	0.19	16.00	0.33	9.84	0.37	15.06	0.61	2.46
	1300								
	1900								
10	0100								
	0700								
	1300								
	1900	0.55	5.56	0.56	5.56	0.47	5.56	0.68	5.45
11	0100	0.68	5.56	0.56	5.56	0.48	5.69	0.58	5.82
	0700	0.47	5.02	0.50	5.12	0.45	5.33	0.56	5.12
	1300	0.39	4.66	0.40	13.48	0.41	13.48	0.41	13.48
	1900	0.40	2.94	0.56	3.08	0.39	12.80	0.60	3.12
12	0100	0.26	13.48	0.38	12.80	0.42	10.24	0.50	6.24
	0700			Operator Error					
	1300	0.23	3.88	0.35	12.80	0.33	3.46	0.52	3.46
	1900	0.28	12.20	0.39	10.24	0.33	3.61	0.62	3.77
13	0100	0.33	12.80	0.34	12.20	0.40	12.80	0.45	8.00
	0700	0.27	5.56	0.35	5.56	0.34	5.69	0.53	5.45
	1300	0.29	5.82	0.36	6.24	0.38	6.09	0.54	5.82
	1900	0.31	5.56	0.38	7.11	0.42	6.57	0.67	6.24
14	0100	0.32	6.74	0.35	6.74	0.39	7.11	0.51	6.09
	0700	0.41	6.40	0.42	8.00	0.42	5.82	0.59	6.09
	1300	0.44	4.20	0.45	4.00	0.43	3.77	0.57	3.82
	1900	0.45	7.11	0.51	7.11	0.53	6.74	0.63	7.32
15	0100	0.39	6.24	0.50	7.32	0.53	7.11	0.58	7.11
	0700	0.33	4.83	0.45	6.92	0.50	6.92	0.62	6.92
	1300	0.29	11.14	0.39	7.76	0.45	7.53	0.44	6.74
	1900	0.31	8.53	0.55	8.26	0.46	9.14	0.51	7.76
16	0100	0.40	9.14	0.43	9.48	0.48	9.14	0.52	5.82
	0700	0.33	16.00	0.40	8.83	0.45	8.26	0.56	8.83
	1300	0.35	15.06	0.38	8.26	0.44	9.14	0.55	8.83
	1900	0.28	8.00	0.45	7.76	0.48	8.83	0.48	8.00

\* Electronic problems

TABLE 3: WAVE DATA

Part 2

JUN 1987

Day	Hour	645		625		181		630	
		Baylor Hmo(m)	at 7+80 T(sec)	Baylor Hmo(m)	at 19+00 T(sec)	Pressure Hmo(m)	Gage T(sec)	Farshr Hmo(m)	Wvrdr T(sec)
17	0100	0.26	16.00	0.34	15.06	0.40	15.06	0.47	8.26
	0700	0.29	14.22	0.35	14.22	0.38	14.22	0.47	8.00
	1300	0.27	14.22	0.35	14.22	0.43	14.22	0.49	14.22
	1900	0.61	3.46	0.71	3.51	0.46	3.51	0.89	3.82
18	0100	0.79	5.69	0.88	4.66	0.62	4.06	1.09	5.45
	0700	0.79	5.56	0.78	4.41	0.59	4.34	1.04	5.22
	1300	0.66	5.22	0.79	5.12	0.59	5.12	0.96	5.22
	1900	0.62	5.69	0.79	5.69	0.64	8.83	0.85	5.56
19	0100	0.50	5.22	0.68	8.53	0.66	8.83	0.81	8.26
	0700	0.48	4.83	0.63	7.53	0.59	8.53	0.73	8.83
	1300	0.44	9.48	0.66	8.83	0.62	9.14	0.76	8.53
	1900	0.38	9.14	0.60	9.14	0.58	9.14	0.71	8.83
20	0100	0.35	8.53	0.53	8.83	0.59	8.83	0.67	8.83
	0700	0.30	9.14	0.46	8.83	0.56	8.83	0.57	8.53
	1300	0.29	8.00	0.47	8.53	0.53	8.53	0.57	8.26
	1900	0.32	8.83	0.52	9.14	0.53	8.53	0.62	8.83
21	0100	0.32	8.53	0.40	8.53	0.47	8.26	0.59	8.00
	0700	0.27	12.20	0.35	8.83	0.43	8.53	0.51	8.53
	1300	0.39	8.83	0.46	8.53	0.46	8.53	0.56	4.74
	1900	0.36	8.83	0.37	8.53	0.43	8.53	0.49	8.83
22	0100	0.28	8.53	0.38	8.53	0.46	8.53	0.52	8.53
	0700	0.33	9.14	0.39	8.53	0.42	9.14	0.57	6.24
	1300	0.37	8.53	0.41	8.53	0.44	8.53	0.54	8.53
	1900	0.30	8.53	0.36	8.53	0.40	8.26	0.48	8.26
23	0100	0.22	8.00	0.32	8.53	0.34	7.53	0.57	7.53
	0700	0.28	15.06	0.34	8.83	0.36	7.76	0.59	2.51
	1300	0.24	8.53	0.38	8.53	0.38	8.00	0.54	5.56
	1900	0.27	14.22	0.38	8.26	0.34	8.53	0.59	8.53
24	0100	0.27	6.09	0.37	8.53	0.41	6.92	0.43	6.74
	0700	0.57	3.16	0.64	3.20	0.39	3.41	0.83	3.41
	1300	1.60	6.40	1.35	5.33	1.05	5.02	1.60	5.95
	1900	1.21	7.11	1.16	7.32	0.97	6.92	1.35	6.74
25	0100	0.99	6.92	1.02	7.53	0.89	6.92	1.13	7.53
	0700	0.87	7.53	0.92	7.53	0.78	7.11	1.05	7.32
	1300	0.54	6.74	0.68	7.32	0.70	7.53	0.68	6.92
	1900	0.54	8.26	0.74	8.00	0.74	8.26	0.81	7.53
26	0100	0.43	8.26	0.72	8.53	0.77	8.26	0.84	7.76
	0700	0.45	8.00	0.71	8.26	0.76	8.83	0.82	8.26
	1300	0.45	7.53	0.74	8.83	0.76	8.83	0.82	8.83
	1900	0.41	8.00	0.67	8.53	0.70	8.26	0.80	8.83
27	0100	0.34	9.48	0.59	8.26	0.66	8.53	0.72	8.26
	0700	0.47	9.48	0.62	9.14	0.72	8.26	0.81	8.83
	1300	0.37	5.69	0.62	9.48	0.71	9.14	0.78	6.40
	1900	0.40	9.14	0.71	8.53	0.66	9.14	0.76	9.14
28	0100	0.31	8.26	0.57	8.83	0.63	8.26	0.67	8.53
	0700	0.84	4.41	0.91	4.49	0.62	4.34	1.07	4.34
	1300	0.69	4.66	0.75	4.74	0.62	4.74	0.83	4.92
	1900	0.47	4.57	0.62	8.26	0.54	7.76	0.72	7.76
29	0100	0.32	8.00	0.49	7.11	0.54	7.53	0.57	8.53
	0700	0.41	6.24	0.51	6.92	0.58	8.00	0.56	6.74
	1300	0.31	6.74	0.53	8.00	0.49	8.00	0.61	7.32
	1900	0.42	7.53	0.47	7.53	0.48	7.76	0.59	8.00
30	0100	0.23	8.26	0.39	8.26	0.45	8.26	0.52	8.26
	0700	0.23	7.76	0.39	8.26	0.49	8.53	0.48	8.00
	1300	0.23	8.26	0.39	8.83	0.43	8.00	0.48	7.76
	1900	0.31	8.53	0.46	9.14	0.52	8.53	0.69	8.26
	Mean	0.43	7.97	0.55	8.13	0.54	8.03	0.67	7.32
	Std dev	0.21	3.06	0.21	2.35	0.15	2.46	0.22	2.16

\* Electronic problems

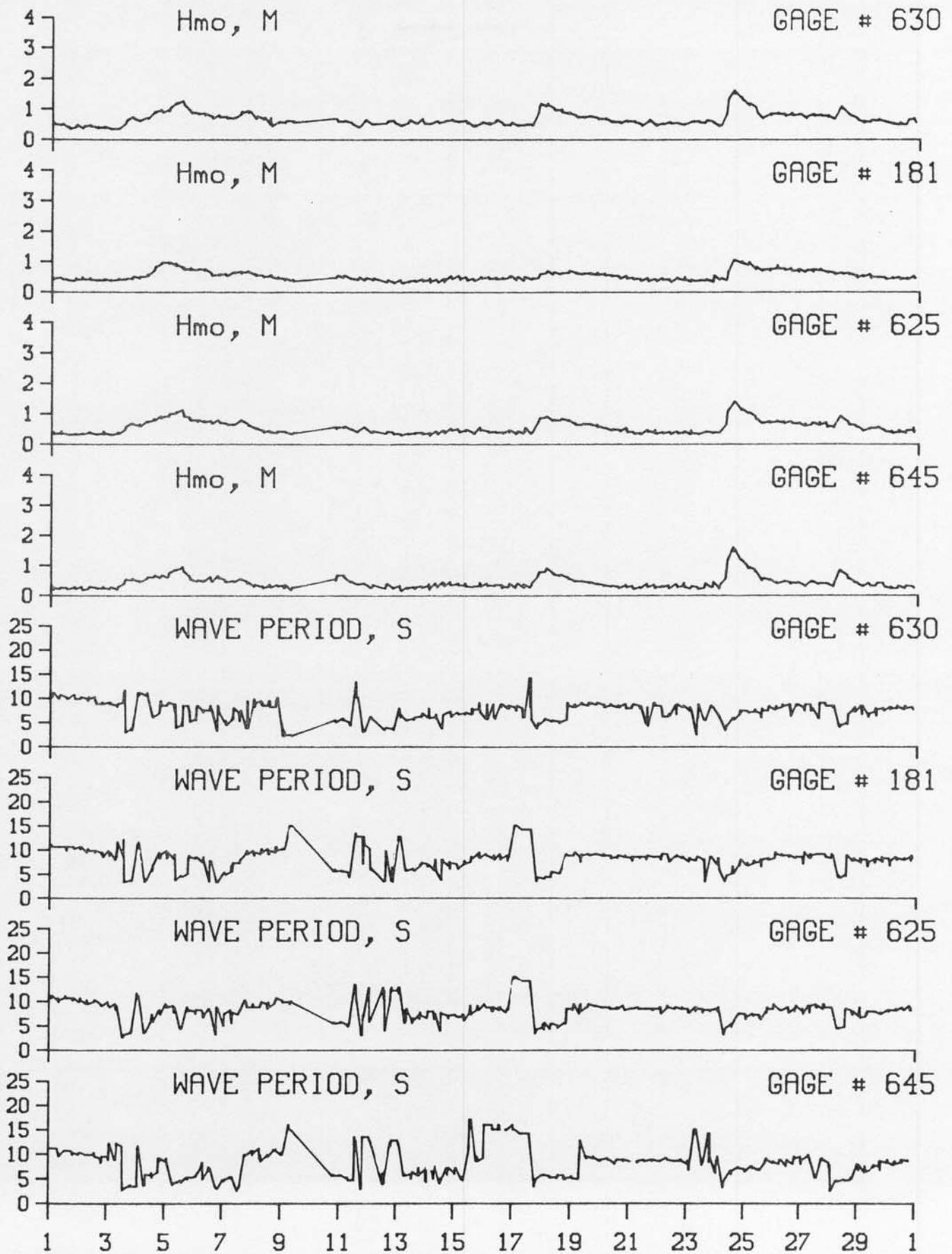


FIGURE 3. Time History of Wave Heights and Periods - June 1987.

#### IV. CURRENT DATA

Current data (Table 4) are collected from a Marsh-McBirney electromagnetic biaxial current meter (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, alongshore currents flow either toward 340 (i.e. northward) or toward 160 (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second.

TABLE 4: Current Data  
JUN 1987

Day	Time	Alongshore Cross-shore Resultant	Pier Measurements					Beach Measurements (500m Updrift)			Current Meter at South Tripod Depth -4.8m (NGVD) ID #679		
			Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface) Location	Speed	Dir	Speed	Dir	
1	0100	Along Cross Result										1 3 3	N off 52
1	0700	Along Cross Result	0 10 10	off 70	140	0 5 5	off 70	North	15	N		3 3 4	N off 25
1	1300	Along Cross Result										3 3 4	S on 205
1	1900	Along Cross Result										12 3 12	N on 326
2	0100	Along Cross Result										4 2 4	N off 7
2	0700	Along Cross Result	8 4 9	S off 133	152	0 0 0		North	15			2 1 2	N off 7
2	1300	Along Cross Result										9 9 13	S on 205
2	1900	Along Cross Result										3 4 5	N off 33
3	0100	Along Cross Result										0 3 3	on 250
3	0700	Along Cross Result	47 0 47	S 160	152	17 0 17	S 160	North	30	N		13 2 13	S on 169
3	1300	Along Cross Result										7 2 7	S on 176
3	1900	Along Cross Result										13 1 13	S on 164
4	0100	Along Cross Result										7 2 7	S off 144
4	0700	Along Cross Result	11 13 16	S on 210	152	6 12 14	N on 277	North	15	S		6 4 7	S on 194
4	1300	Along Cross Result										12 3 12	S on 174
4	1900	Along Cross Result										4 0 4	S 160
5	0100	Along Cross Result										7 3 8	N on 317
5	0700	Along Cross Result	61 0 61	S 160	152	30 12 33	S on 182	North	37	S		23 2 23	S on 165
5	1300	Along Cross Result										24 3 24	S on 167
5	1900	Along Cross Result										21 5 22	S on 173

TABLE 4: Current Data  
JUN 1987

Day	Time	Pier Measurements					Beach Measurements (500m Updrift)			Current Meter at South Tripod Depth -4.8m (NGVD) ID #679	
		Dye at (579 m) (surface) Speed Dir		Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Location	Dye 12m offshore (surface) Speed	Dir	Speed	Dir
6	0100	Along Cross Result								15 2 15	S off 152
6	0700	Along Cross Result	61 9 62	S on 169	213	41 4 41	N on 334	North	68	S 12 1 12	S on 165
6	1300	Along Cross Result								31 10 33	S on 178
6	1900	Along Cross Result								12 4 13	S on 178
7	0100	Along Cross Result								6 2 6	S off 142
7	0700	Along Cross Result	10 2 10	N off 349	226	9 11 15	S off 110	North	36	S 1 3 3	S on 232
7	1300	Along Cross Result								4 0 4	S 160
7	1900	Along Cross Result								1 1 1	S off 115
8	0100	Along Cross Result								10 4 11	N off 2
8	0700	Along Cross Result	7 18 19	N off 48	146	25 19 32	N on 303	South	15	S 5 6 8	N off 30
8	1300	Along Cross Result								9 5 10	N off 9
8	1900	Along Cross Result								4 2 4	N off 7
9	0100	Along Cross Result								7 6 9	N off 21
9	0700	Along Cross Result	4 12 13	N off 52	143	20 10 23	N on 313	North	20	N 2 4 4	S off 97
9	1300	Along Cross Result									
9	1900	Along Cross Result									
10	0100	Along Cross Result									
10	0700	Along Cross Result	44 0 44	S 160	152	76 0 76	S 160	North	56	S	
10	1300	Along Cross Result									
10	1900	Along Cross								26 6 27	N on 327

TABLE 4: Current Data  
JUN 1987

Day	Time	Alongshore Cross-shore Resultant	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter at South Tripod Depth -4.8m (NGVD) ID #679		
			Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface) Location	Speed	Dir	Speed	Dir
11	0100	Along Cross Result									14 4 15	S on 176
11	0700	Along Cross Result	44 0 44	S  160	140	28 7 29	S on 174	North	14	S	22 7 23	S on 178
11	1300	Along Cross Result									8 4 9	S on 187
11	1900	Along Cross Result									7 2 7	S off 144
12	0100	Along Cross Result									3 1 3	N off 358
12	0700	Along Cross Result	34 8 35	N off 354	140	17 8 19	N off 7	South	17	N		
12	1300	Along Cross Result									10 4 11	N off 2
12	1900	Along Cross Result									11 3 11	N off 355
13	0100	Along Cross Result									6 4 7	N off 14
13	0700	Along Cross Result	8 4 9	N on 316	213	0 5 5	off 133	South	3	N	4 3 5	N off 17
13	1300	Along Cross Result									2 4 4	N on 277
13	1900	Along Cross Result									17 3 17	N off 350
14	0100	Along Cross Result									4 1 4	N off 354
14	0700	Along Cross Result	no observ		213	0 0 50	81	South	9	N	5 3 6	N off 11
14	1300	Along Cross Result									5 1 5	S off 149
14	1900	Along Cross Result									7 2 7	N off 356
15	0100	Along Cross Result									2 1 2	S on 187
15	0700	Along Cross Result	9 12 15	N off 33	238	9 9 12	N off 25	South	13	N	4 2 4	N off 7
15	1300	Along Cross Result									4 2 4	S on 187
15	1900	Along Cross Result									7 2 7	N off 356

KEY = All speeds in CM/SEC  
N = Northward, Shore parallel

TABLE 4: Current Data  
JUN 1987

Day	Time	Alongshore Cross-shore Resultant	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter at South Tripod Depth -4.8m (NGVD) ID #679		
			Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Location	Dye 12m offshore (surface) Speed	Dir	Speed	Dir
16	0100	Along Cross Result									5 2 5	N off 2
16	0700	Along Cross Result	8 17 19	N off 45	140	24 9 26	N on 321	South	6	S	4 3 5	N off 17
16	1300	Along Cross Result									1 2 2	S off 97
16	1900	Along Cross Result									3 3 4	N on 295
17	0100	Along Cross Result									4 4 6	N on 295
17	0700	Along Cross Result	5 11 12	S off 95	152	38 15 41	N on 318	South	3	N	2 0 2	N 340
17	1300	Along Cross Result									17 1 17	S on 163
17	1900	Along Cross Result									26 5 26	S on 171
18	0100	Along Cross Result									18 7 19	S on 181
18	0700	Along Cross Result	30 30 43	S on 205	165	16 16 23	N on 295	North	3	S	11 8 14	S on 196
18	1300	Along Cross Result									23 6 24	S on 175
18	1900	Along Cross Result									10 3 10	S on 177
19	0100	Along Cross Result									4 1 4	N on 326
19	0700	Along Cross Result	0 12 12	on 250	165	61 61 86	N on 295	South	6	S	7 1 7	S on 168
19	1300	Along Cross Result									1 1 1	S on 205
19	1900	Along Cross Result									2 1 2	S on 187
20	0100	Along Cross Result									3 0 3	N 340
20	0700	Along Cross Result	34 20 39	N on 309	238	20 9 22	N off 4	South	30	N	4 1 4	S on 174
20	1300	Along Cross Result									5 0 5	N 340
20	1900	Along Cross Result									0 0 0	

TABLE 4: Current Data  
JUN 1987

Day	Time	Alongshore Cross-shore Resultant	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter at South Tripod Depth -4.8m (NGVD) ID #679		
			Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed Dir		Dye 12m offshore (surface) Location	Speed Dir		Speed	Dir
			Speed	Dir		Speed	Dir		Speed	Dir		
21	0100	Along Cross Result							4 4 6	N off 25		
21	0700	Along Cross Result	7 12 14	N off 40	226	8 3 8	N off 2	South	5 N	1 2 2	S off 97	
21	1300	Along Cross Result								3 3 4	N off 25	
21	1900	Along Cross Result								0 3 3	on 250	
22	0100	Along Cross Result								4 1 4	N on 326	
22	0700	Along Cross Result	9 2 9	N off 354	165	24 6 25	N on 326	South	7 N	2 2 3	S off 115	
22	1300	Along Cross Result								7 1 7	N on 332	
22	1900	Along Cross Result								11 4 12	N on 320	
23	0100	Along Cross Result								5 4 6	N off 19	
23	0700	Along Cross Result	6 25 26	N off 57	146	22 5 22	N off 354	South	8 N	1 4 4	N off 56	
23	1300	Along Cross Result								5 2 5	N off 2	
23	1900	Along Cross Result								9 2 9	N on 327	
24	0100	Along Cross Result								3 3 4	N on 295	
24	0700	Along Cross Result	41 10 42	S on 174	140	61 30 68	S on 187	North	84 S	13 9 16	S on 195	
24	1300	Along Cross Result								47 5 47	S on 166	
24	1900	Along Cross Result								33 10 34	S on 177	
25	0100	Along Cross Result								16 3 16	S on 171	
25	0700	Along Cross Result	41 4 41	S on 166	152	61 15 63	S on 174	North	5 S	21 7 22	S on 178	
25	1300	Along Cross Result								15 7 17	S on 185	
25	1900	Along Cross Result								6 4 7	S off 126	

KEY = All speeds in CM/SEC  
N = Northward, Shore parallel

TABLE 4: Current Data  
JUN 1987

Day	Time	Alongshore Cross-shore Resultant	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter at South Tripod Depth -4.8m (NGVD) ID #679		
			Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface) Location	Speed	Dir	Speed	Dir
26	0100	-Along Cross Result								2 2 3	N on 295	
26	0700	-Along Cross Result	4 2 5	N off 7	152	5 10 11	S on 223	South	23	S	2 2 3	S off 115
26	1300	-Along Cross Result									8 2 8	S off 146
26	1900	-Along Cross Result									1 2 2	N off 43
27	0100	-Along Cross Result									4 1 4	S on 174
27	0700	-Along Cross Result	4 2 5	S on 187	152	12 2 12	N on 331	South	5	N	4 2 4	S on 187
27	1300	-Along Cross Result									0 2 2	off 70
27	1900	-Along Cross Result									4 8 9	N on 277
28	0100	-Along Cross Result									2 1 2	S off 133
28	0700	-Along Cross Result	38 10 39	S on 174	140	61 0 61	S on 160	North	5	S	21 2 21	S on 165
28	1300	-Along Cross Result									19 12 22	S on 192
28	1900	-Along Cross Result									5 1 5	N on 329
29	0100	-Along Cross Result									6 1 6	N off 349
29	0700	-Along Cross Result	16 12 20	N off 17	140	38 0 38	N 340	South	14	N	4 1 4	N on 326
29	1300	-Along Cross Result									1 4 4	S on 236
29	1900	-Along Cross Result									18 2 18	N off 346
30	0100	-Along Cross Result									19 3 19	N on 331
30	0700	-Along Cross Result	24 13 28	N off 9	250	20 7 22	N off 359	South	18	N	15 4 16	N on 325
30	1300	-Along Cross Result									10 8 13	N on 301
30	1900	-Along Cross Result									9 2 9	N off 353

KEY = All speeds in CM/SEC  
N = Northward  
S = Southward  
off = offshore  
on = onshore

## V. SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) taken at the seaward end of the pier are made of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves) but not surface chop or capillary waves. The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring alignment of the wave crests. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70 east of true north; consequently, wave angles greater than 70 imply the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are made daily at the seaward end of the FRF pier. A jar along with a thermometer is lowered about .3 m (1 ft) into the water and allowed to remain for at least one minute. The jar is removed, the temperature read and a hydrometer is used to determine the density. A secci disc is used to determine the surface visibility.

TABLE 5  
 SUPPLEMENTAL OBSERVATIONS  
 -----  
 JUN 1987

DAY	TIME	WAVE APPROACH ANGLE AT PIER END		RADAR WAVE ANGLE deg from True N	WIDTH OF SURF ZONE(m)	WATER CHARACTERISTICS		
		Primary	Secondary			A	PIER END DENSITY (g/cc)	SECCI VIS(m)
1	935	100		90	46	15.8	1.0227	2.1
2	725	100		90	50	15.6	1.0229	1.8
3	750	90		80	46	21.6	1.0200	3.0
4	741	90		90	91	22.5	1.0190	2.4
5	730	50		60	87	22.2	1.0179	1.5
6	1143	45	50	50	50	22.8	1.0186	3.0
7	1130	50	40	50	50	22.8	1.0200	3.0
8	927	100		80	84	16.1	1.0228	1.2
9	732	100		80	43	16.1	1.0233	2.4
10	733	40		60	79	14.5	1.0238	2.4
11	726	50		60	52	20.0	1.0189	3.0
12	835	90		80	43	17.9	1.0216	2.4
13	930	none	visible	55	3	17.8		4.3
14	1100	none	visible	50	14	15.5	1.0236	3.0
15	930	45	40	50	38	16.0	1.0239	4.3
16	816	110		85	24	17.0	1.0236	3.4
17	800	95		85	47	15.6	1.0234	4.3
18	830	50		60	63	22.2	1.0198	4.0
19	800	100		100	67	22.5	1.0188	4.3
20	1115	55	50	50	61	22.8	1.0214	3.7
21	1040	none	visible	85	60	17.0	1.0236	2.7
22	750	100	100	85	55	16.1	1.0235	4.0
23	800	105	105	85	21	16.1	1.0235	3.7
24	800	25	25	60	70	16.7	1.0234	5.2
25	745	55	55	40	70	20.8	1.0203	3.0
26	750	45	40	55	58	22.2	1.0198	4.3
27	730	75	70	60	58	21.1	1.0208	3.0
28	815	45	45	60	43	20.9	1.0218	3.0
29	824	90	60	90	44	22.2	1.0208	4.3
30	959	none	visible	70	37	21.7	1.0212	3.4

## VI. WATER LEVELS

The National Ocean Services (NOS) has established a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect data every 6 minutes throughout the month.

Figure 4 shows the variation in mean water levels computed over a tidal cycle period (12.42 hours), and contains a list of selected mean and extreme values. This presentation is useful in identifying effects on both meteorological and astronomical forces on the open coast water levels.

Table 6 contains the time of the center of each sampling interval and the range, high, low, and mean water levels during each tidal cycle.

FRF TIDE HEIGHTS  
JUN 1987

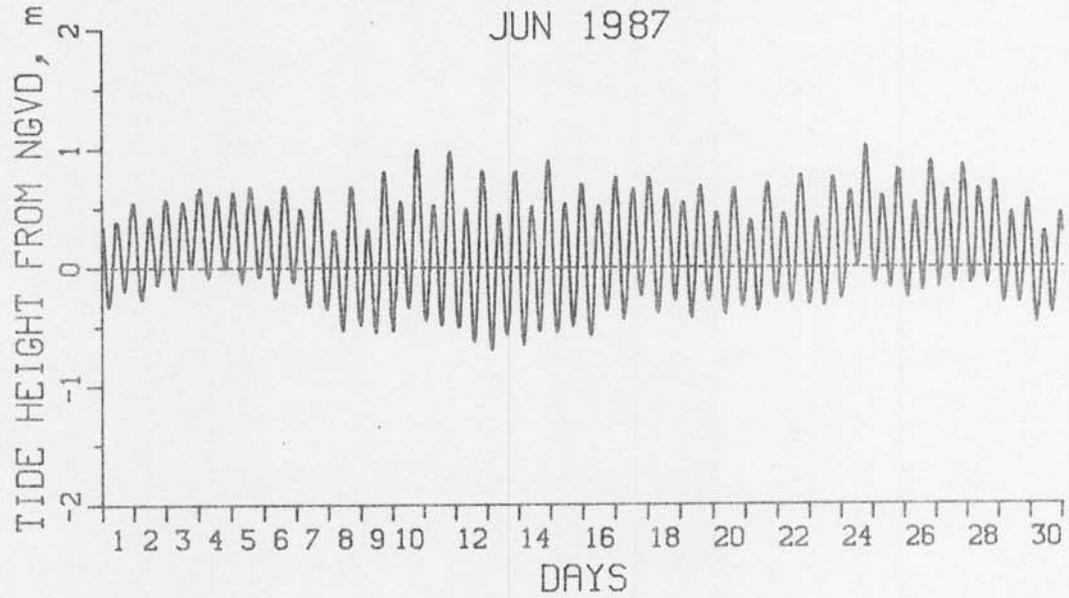


FIGURE 4. Time History of Mean Water Levels, June 1987

MONTHLY WATER LEVELS (METERS MSL)		
EXTREME LOW	=	-0.69 ON DAY 13 AT 230HRS.
EXTREME HIGH	=	1.02 ON DAY 24 AT 1754HRS.
MONTHLY MEAN	=	0.15
MEAN LOW	=	-0.33
MEAN HIGH	=	0.67
MEAN RANGE	=	1.00

Table 6: WATER LEVELS (METERS NGVD)

MID-CYCLE DAY TIME	LOW	HIGH	MEAN	RANGE
1 612	-0.33	0.39	0.05	0.72
1 1837	-0.20	0.55	0.17	0.75
2 703	-0.27	0.43	0.08	0.70
2 1928	-0.15	0.58	0.21	0.73
3 753	-0.19	0.55	0.18	0.74
3 2018	0.00	0.67	0.33	0.67
4 843	-0.09	0.61	0.26	0.69
4 2109	-0.01	0.64	0.30	0.65
5 934	-0.12	0.69	0.27	0.81
5 2159	-0.08	0.53	0.24	0.60
6 1024	-0.25	0.69	0.21	0.94
6 2249	-0.12	0.54	0.21	0.66
7 1115	-0.34	0.68	0.15	1.02
7 2340	-0.35	0.50	0.03	0.85
8 1205	-0.53	0.68	0.04	1.22
9 30	-0.48	0.45	-0.04	0.94
9 1255	-0.55	0.81	0.08	1.36
10 121	-0.53	0.56	0.05	1.09
10 1346	-0.34	0.99	0.29	1.33
11 211	-0.45	0.73	0.10	1.18
11 1436	-0.49	0.98	0.20	1.46
12 301	-0.51	0.70	0.04	1.21
12 1527	-0.63	0.81	0.06	1.44
13 352	-0.69	0.66	-0.07	1.35
13 1617	-0.57	0.81	0.08	1.37
14 442	-0.66	0.59	-0.03	1.25
14 1707	-0.54	0.90	0.14	1.44
15 532	-0.55	0.65	0.03	1.20
15 1758	-0.50	0.70	0.09	1.20
16 623	-0.58	0.55	-0.01	1.12
16 1848	-0.37	0.76	0.17	1.12
17 713	-0.44	0.66	0.12	1.10
17 1938	-0.24	0.76	0.25	0.99
18 804	-0.38	0.65	0.14	1.03
18 2029	-0.29	0.59	0.16	0.88
19 854	-0.43	0.68	0.11	1.11
19 2119	-0.29	0.60	0.14	0.89
20 944	-0.40	0.66	0.10	1.06
20 2210	-0.33	0.62	0.09	0.95
21 1035	-0.37	0.71	0.11	1.08
21 2300	-0.26	0.68	0.16	0.94
22 1125	-0.30	0.77	0.19	1.07
22 2350	-0.31	0.73	0.13	1.04
23 1216	-0.33	0.75	0.16	1.08
24 41	-0.27	0.67	0.19	0.93
24 1306	0.00	1.02	0.45	1.02
25 131	-0.13	0.87	0.30	1.01
25 1356	-0.17	0.82	0.30	1.00
26 222	-0.26	0.70	0.18	0.96
26 1447	-0.20	0.89	0.31	1.09
27 312	-0.17	0.76	0.30	0.93
27 1537	-0.13	0.86	0.34	0.99
28 402	-0.14	0.69	0.26	0.83
28 1628	-0.14	0.72	0.29	0.86
29 453	-0.30	0.52	0.10	0.83
29 1718	-0.30	0.56	0.12	0.87
30 543	-0.47	0.31	-0.06	0.79
30 1808	-0.39	0.45	0.01	0.84

## VII. NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Zeiss surveying system; a Zeiss Elta-2 first-order, self-recording electronic theodolite distance meter in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 5 shows the last survey in May and the only survey taken during June on profile line 188 located 517 m south of the pier. A small amount of erosion is visible on the foreshore (60 to 140 m) while the nearshore bar moved shoreward beginning to mold itself to the beach. Only minor changes are visible on the remainder of the profile.

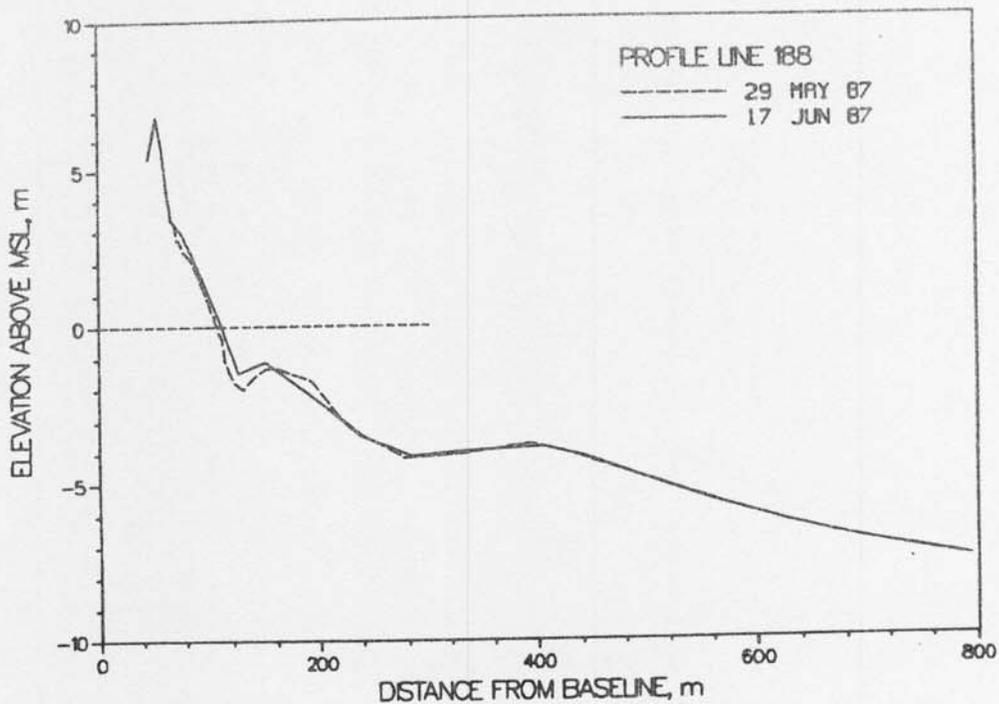


Figure 5. Monthly CRAB profiles on profile 188 - 517 meters south of pier.

The profile envelope (Figure 6) reflects the maximum changes that occurred on the profile since the end of 1986. The change to the envelope (130 m) is a result of the shoreward movement of the nearshore bar.

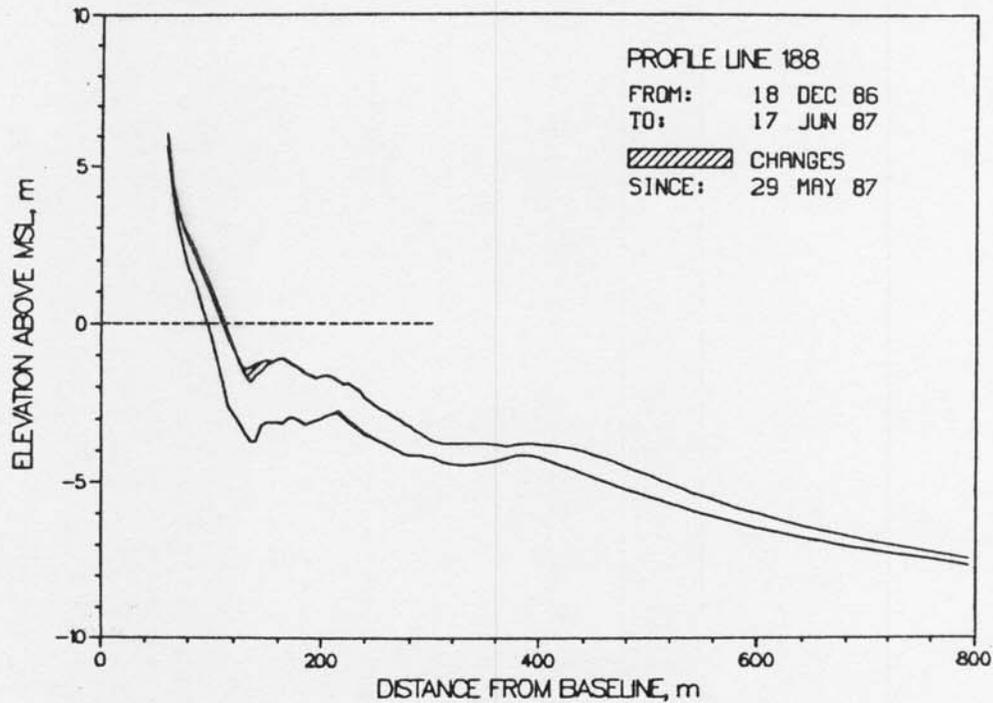


Figure 6. CRAB profile envelope - profile 188.

B. Bathymetry. Figure 7 is a contour map showing the bathymetry around the pier on 17 June.

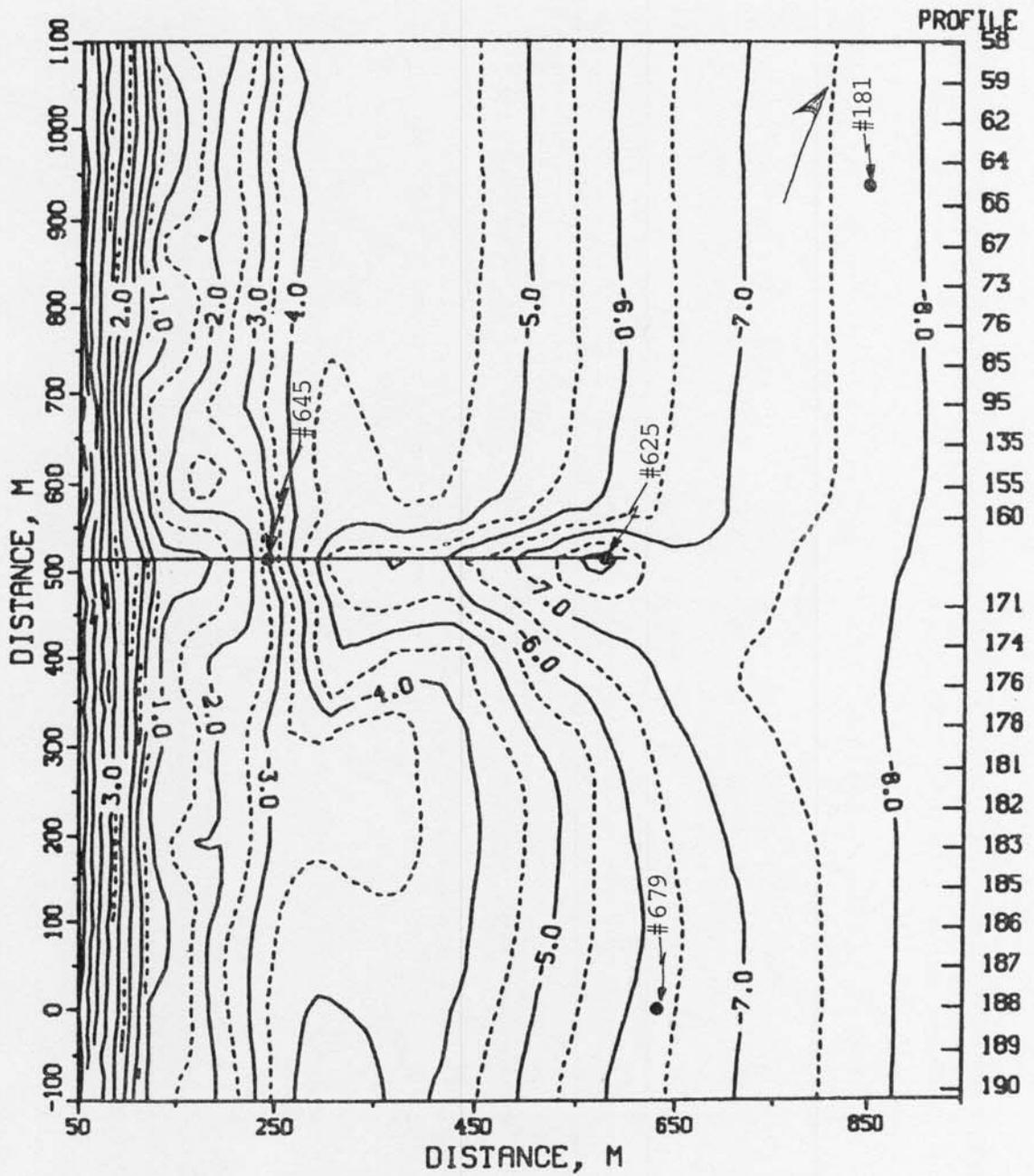


Figure 7. FRF BATHYMETRY 17 JUN 87  
CONTOURS IN METERS

## Distribution List

### Government Agencies:

OCE  
BERH  
NAO  
NASA/Wallops Flight Center  
NOAA (NOS, NWS)  
SAD  
SAW

U.S. Geological Survey  
U.S. National Park Service  
U.S. Naval Academy  
U.S. Naval Civil Eng. Lab  
U.S. Naval Fac. Eng. Com.  
U.S. Naval Oceanographic Off.  
U.S. Naval Research Lab

### Colleges/Universities:

California Inst. of Tech.  
East Carolina University  
Florida Inst. of Tech.  
Harvard University  
Naval Post Graduate School  
NC State University  
Old Dominion University  
Oregon State University  
Prince George's College  
Rutgers University  
Scripps Inst. of Oceanography  
Southern Illinois University

Stockton State College  
University of Akron  
University of Delaware  
University of Florida  
University of Maryland  
University of Miami  
University of North Carolina  
University of N. Colorado  
University of Rhode Island  
University of Virginia  
Va. Inst. of Marine Science

### Others:

City of Va. Beach, VA  
Coastal Barge Corporation  
Coastal and Est. Res., Inc.  
Coastal Science & Eng., Inc.  
Codar Ocean Sensors Ltd.  
Dr. Galvin  
GEOMET Tech., Inc.  
Greenhorne & O'Mara, Inc.  
Dr. Hylton  
Mary Marr, Inc.  
Masonite Corporation

MEC Systems Corporation  
Moffatt & Nichol, Eng.  
Offshore Coastal Technologies  
Mr. Rowland  
Mr. Savage  
Sea Port Supply Corp.  
Shell Development  
Sherwood Industries  
Sohio Petroleum Co.  
Mr. & Mrs. Valpey  
WCTI-TV

### Foreign:

W. F. Baird & Asso. Coastal Engineers, Ltd (Canada)  
Queen's University, Ontario (Canada)  
Ministry of Construction, Coastal Division (Japan)  
Norwegian Hydrodynamic Laboratories (Norway)  
University of New South Wales (Australia)  
University of Sydney (Australia)